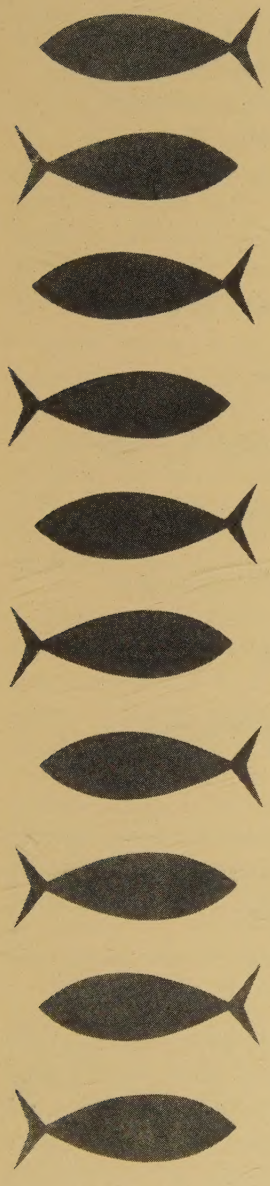
# Southwest FISHERIES SCIENCE CENTER

HONOLULU LA JOLLA MONTEREY TIBURON

## REPORT OF ACTIVITIES March-April 1993

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## ANTARCTIC ECOSYSTEM RESEARCH GROUP

La Jolla, California

### 1992-93 AMLR Research Cruise Completed

Following a mid-cruise port call, the NOAA ship *Surveyor* departed from Punta Arenas, Chile, on February 14, 1993, to begin Leg II of the Antarctic Marine Living Resources (AMLR) Program's annual research cruise in the waters surrounding Elephant Island, Antarctica. While in transit across the Drake Passage, a series of expendable bathythermograph observations was made by personnel from Chile's Servicio Hidrográfico y Oceanográfico de la Armada to monitor the thermal structure of the upper ocean layers. The ship arrived at Seal Island, a small island off the coast of Elephant Island, on February 17 to provide provisions and mail to a field team stationed there since early December 1992.

After the resupply was completed, a series of acoustic transects was completed immediately north of Seal Island while the ship towed a radio transmitter. The transmitter was similar to one used by the Seal Island field team to monitor penguins during foraging trips; data collected will be used to interpret observations made with an automatic frequency scanning receiver on Seal Island.

On February 19, a small-area acoustic survey was conducted north of Elephant Island. The survey was conducted at a speed of approximately 10 knots, 17 hours per day over a 3-day period. Acoustic transects were conducted using 120-kHz and 200-kHz transducers mounted in a dead-weight towed body. Directed Issacs-Kidd Midwater Trawls (IKMT) and Multiple-Opening-Closing-Net-Environmental-Sampling-System (MOCNESS) tows were accomplished during the dark hours.

Following the completion of the small-area survey, a large-area survey of 91 conductivity-temperature-depth (CTD)/rosette stations, separated by acoustic transects, was initiated on February 22 around Elephant, Clarence, and Gibbs Islands. Operations at each station included (a) measurement of temperature, salinity, oxygen, light levels, light beam transmission, and fluorescence profiles; (b) collection of discrete water samples at standard depths for analysis of chlorophyll-a content, absorption spectra, particulate organic carbon and nitrogen concentrations, primary production, ATP and DNA content, size fractionation, floristics, and inorganic nutrient content; and (c) deployment of a large plankton net to obtain samples of zooplankton and nekton.

A transect with CTD/rosette stations was completed across Bransfield Strait, south of King George Island, in order to delineate hydrographic and biological features. Macronekton samples were obtained with an IKMT at the southern-most two stations. Directly following this, two similar transects were conducted across the shelf break north of Elephant Island.

The last survey of Leg II, another small-area acoustic survey, was conducted north of Elephant Island March 9-12. As before, directed net tows (IKMT and MOCNESS) were conducted during the dark hours.

On March 11, as part of the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) Inspection Program, the Polish fishing vessel *Lyra* was boarded and inspected by Chief Scientist Roger Hewitt and ENS Alexandra Von Saunder, of NOAA Corps; both Hewitt and Von Saunder are designated CCAMLR inspectors. *Lyra* was fishing exclusively for krill in the vicinity of Elephant Island; she had previously been fishing for krill in the South Orkney Islands. The inspection went very well; the Captain of the ship was very cooperative and the vessel appeared to be well run. No violations of CCAMLR regulations were found.

Following the recovery of the field team from Seal Island, *Surveyor* returned to Punta Arenas, Chile, on March 15, bringing to a close the 1992-93 AMLR field season. (J. Rosenberg, [619] 546-5600)

## COASTAL FISHERIES RESOURCES DIVISION

La Jolla, California

### Northern Anchovy Biomass Model Developed

Fishery Biologist Larry Jacobson, Statistician N. Chyan-Huei Lo and Tom Barnes (California Department of Fish and Game, Long Beach) used a new model and index of egg production to assess trends in abundance of northern anchovy, *Engraulis mordax*, off southern California and Baja California,

Mexico, during the 1963-1991 seasons. The model used prior information about recruitment variability and a Bayesian constraint on recruitment estimates in lieu of age composition data. In terms of complexity, the new model for anchovy was a compromise between simple surplus production and complex age structured models. It worked well for northern anchovy as age composition data are incomplete and difficult to interpret.

The new egg production index for northern anchovy, which was used in the model to estimate biomass, had not been used previously because the length of the time series (beginning in the 1979 season) was short and because of the need to maintain consistency with egg production estimates for anchovy in earlier seasons. The new estimates of egg production for northern anchovy were similar to estimates made using other methods but are considered more precise.

Biomass of northern anchovy age 1 and older ranged from 267 to 574 (average was 390) thousand metric tons (t) during the 1963-1972 seasons (Fig. 1). Anchovy biomass increased dramatically to 1,670 thousand t in the 1973 season and remained at high levels (980 to 1,670 thousand t, with an average of 1,360 t) during 1973-1976. Biomass declined after 1976 and ranged from 353 to 1,007 (with an average of 620) thousand t during the 1977-1988 seasons. Biomass levels after the 1988 season ranged from 252 to 343 (with an average of 310) thousand t. Coefficients of variation (CV) for anchovy biomass estimates ranged from 23 percent to 50 percent, except for the 1979-1984 seasons when CVs ranged from 11 percent to 19 percent.

Ricker recruitment models were fit to the spawner-recruit estimates for northern anchovy

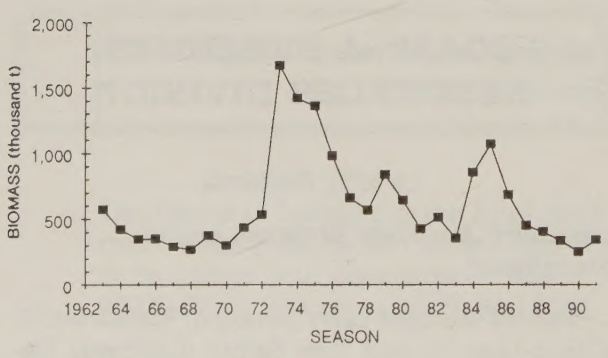


Figure 1. Biomass (thousand metric tons [t] of northern anchovy age 1 and older) during the middle of February in the 1963-1991 seasons.

from the new model to determine whether spawning biomass levels affected recruitment success. Linear regression analysis indicated a statistically significant relationship between anchovy spawning biomass and log reproductive success ($P<0.001$, $R^2=0.28$). Residuals from spawner-recruit models were serially correlated, indicating runs of poorer-than-expected recruitment success occurred during the 1963-1968 and 1984-1989 seasons and better-than-expected recruitment success during the 1969-1974 seasons.

Spawner-recruit models for fish (like anchovy) that spawn more than once per year are easier to interpret when expressed in units of "resulting" spawning biomass. Resulting spawning biomass is the theoretical lifetime spawning biomass for a cohort (or the sum of the spawning biomass for a cohort during each year of its life). Jacobson, Lo, and Barnes calculated resulting spawning biomass for a given biomass of recruitment assuming no fishing mortality. Resulting spawning biomass can be compared to the replacement line where spawning biomass and resulting spawning biomass are equal (Fig. 2).

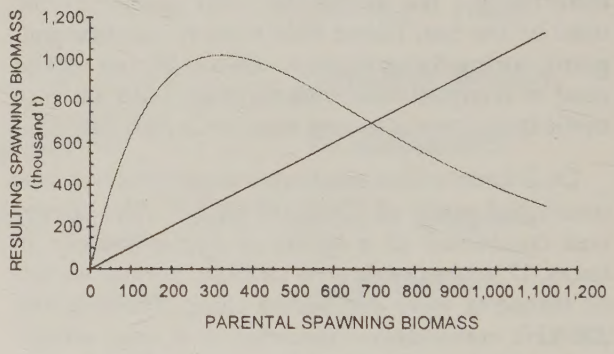


Figure 2. Theoretical "resulting" spawning biomass and parental spawning biomass (thousand metric tons [t]) for northern anchovy, assuming no fishing mortality. The replacement line is the straight line drawn through the origin.

On the basis of this model, maximum surplus production of spawning biomass for anchovy (maximum resulting spawning biomass above the replacement level) with no fishing occurs at about 200 to 300 thousand t and equilibrium biomass with no fishing is about 650 to 800 thousand t. Current management of northern anchovy eliminates large-scale reduction fishing when spawning biomass drops below 300 thousand t (Pacific Fishery Man-

agement Council 1991). This cutoff for large-scale reduction fishing is about the same as the biomass at which maximum surplus production occurs.

Status of the Stock

Anchovy biomass (Fig. 1) and recruitment levels declined after the 1986 season to levels similar to those during the 1963-1971 seasons. Anchovy have been too scarce off Baja California, Mexico, since the 1990 season to support a significant fishery. Declines in biomass during recent years were probably due to low recruitment rather than high fishing mortality rates since fishing mortality rates were moderate after the 1986 season ($<0.14\ yr^{-1}$) and very low ($<0.02\ yr^{-1}$) during the 1990-1991 seasons.

The declining trend in anchovy recruitment appears to be due to a run of years with adverse environmental conditions rather than to low spawning biomass. Spawning biomass after the 1986 season averaged about 300 thousand t and spawner-recruit analysis indicates that surplus production for anchovy recruitment is, on average, near maximum for spawning biomass levels around 300 t. The recent period of low anchovy biomass occurred as sardine biomass levels began to increase in the early 1980s and water temperatures began to warm. (L. Jacobson, [619] 546-7117 and N. C. Lo, [619] 546-7123)

## MARINE MAMMAL DIVISION

La Jolla, California

### Status of California Cetacean Stocks Workshop Held

A workshop was held March 31-April 2, 1993, at the Southwest Fisheries Science Center (SWFSC) in La Jolla, California, to review scientific information on the status of cetacean species that are found in California coastal waters. Experts on various aspects of marine mammal research were invited from universities, private research groups, and other government agencies throughout the country. This panel, together with members of the SWFSC scientific staff, reviewed a series of papers that had been prepared by the SWFSC staff. These papers and a series of background papers provided recent information on the population size and structure, biology, and incidental fishery mortality of cetacean species that are found off California. Table 1 summarizes the findings from this review. The reason for this review was to ensure that the highest quality scientific advice would be provided to managers who are responsible for the conservation of these populations.

The chairman of the workshop, Steve Reilly, acting chief of the Marine Mammal Division at SWFSC, made the opening remarks, explained logistics for the following 3-day workshop, and described its format. The rapporteur, Joyce Sisson, wildlife biologist, took notes on the subsequent discussions. The notes have been compiled and incorporated into a workshop report, which will be available by the end of May.

Management Regime

Jay Barlow, leader of the Coastal Marine Mammal Program, gave a brief review of the current and proposed marine mammal management regimes: The Marine Mammal Protection Act (MMPA) of 1972 governs the management of marine mammals in the United States. Prior to the 1988 amendments to the MMPA, fisheries could only be granted permits to take marine mammals incidentally if there were scientific evidence to prove that all stocks of marine mammals involved in the fisheries were at or above their optimum sustainable population (OSP) levels. However, sufficient evidence regarding status relative to OSP only exists for a few stocks. Due to problems and economic losses associated with implementation of this act, it was amended in 1988 to allow a 5-year interim exemption period, during which time the incidental taking of marine mammals was permitted in commercial fishing operations. During the 5-year period, it was expected that additional information would be gathered on the species involved and on the nature and extent of their interactions with different fisheries. This period ends on October 1, 1993, at which time the old system will go back into effect unless new legislation is adopted.

The old system of management under the MMPA was to maintain marine mammals as functioning elements of their ecosystem at their OSP levels. As the MMPA has been interpreted, OSP is defined as the population level between carrying capacity of the environment and that level which yields the maximum net production. This management regime put a limitation on kills of marine mammals so that their populations would not be reduced below their OSP levels. In order for a population to be considered depleted, it must be proved that it is below its OSP level. The requirement to determine status of populations relative to OSP is viewed by many to be a weakness in the

| Species | Ship Survey | | Aerial Survey | | Best Estimates | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Log-Normal 95% Confidence Interval | | |
| | Abundance | CV | Abundance | CV | Abundance | CV | Lower | Upper | Source |
| Baird's beaked whales | 86 | 1.070 | | | 86 | 1.070 | 16 | 477 | 4 |
| mesoplodont beaked whales | 314 | 1.123 | | | 314 | 1.123 | 53 | 1,844 | 4 |
| Cuvier's beaked whales | 2,031 | 0.847 | | | 2,031 | 0.847 | 481 | 8,584 | 4 |
| unidentified beaked whale | 1,656 | 1.166 | | | 1,656 | 1.166 | 269 | 10,180 | 4 |
| pygmy sperm whales | 398 | 1.443 | | | 398 | 1.443 | 50 | 3,184 | 4 |
| short-beaked common dolphins | 257,713 | 0.277 | | | 257,713 | 0.277 | 151,249 | 439,116 | 1 |
| long-beaked common dolphins | 13,937 | 0.593 | | | 13,937 | 0.593 | 4,752 | 40,872 | 1 |
| unclassified common dolphins | 3,572 | 0.650 | | | 3,572 | 0.650 | 1,116 | 11,435 | 1 |
| Risso's dolphins | 8,409 | 0.403 | 28,809 | 0.450 | 18,609 | 0.360 | 9,387 | 36,889 | 3 |
| Pacific white-sided dolphins | 14,766 | 0.545 | 110,398 | 0.440 | 62,582 | 0.393 | 29,755 | 131,623 | 3 |
| northern right whale dolphins | 11,969 | 0.618 | 19,835 | 0.430 | 15,902 | 0.355 | 8,095 | 31,239 | 3 |
| killer whales | 309 | 1.413 | 62 | 0.750 | 186 | 1.184 | 30 | 1,161 | 3 |
| striped dolphins | 20,621 | 0.486 | | | 20,621 | 0.486 | 8,363 | 50,848 | 2 |
| Dall's porpoise | 76,032 | 0.355 | 8,489 | 0.230 | see below (bias-corrected Dall's porpoise) | | | | |
| bottlenose dolphins | 1,504 | 0.542 | 2,959 | 0.500 | 2,232 | 0.378 | 1,089 | 4,571 | 3 |
| Derived Estimates: | | | | | | | | | |
| total common dolphins | 275,222 | 0.261 | 270,983 | 0.310 | 273,103 | 0.202 | 184,388 | 404,500 | 3 |
| bias-corrected Dall's porpoise | 18,080 | 0.491 | 26,201 | 0.288 | 22,141 | 0.263 | 13,337 | 36,756 | 3,5 |
| total beaked whales | 4,087 | 0.639 | 426 | 0.380 | 4,087 | 0.639 | 1,298 | 12,867 | 4 |

Sources:

1 Best estimates taken from ship survey only; common dolphin types could not be discriminated from the air.

2 Best estimates taken from ship survey only; striped dolphins are primarily outside aerial survey area.

3 Best estimates taken as average of ship and aerial surveys; CVs based on additive variance.

4 Best estimates taken from ship survey only; greater bias expected in aerial estimates due to diving animals.

5 Bias correction factors for Dall's porpoise were 3.08 (CV=0.173) for aerial and 0.238 (CV=0.339) for ship.

Table 1. Combined estimates of abundance for odontocetes based on the 1991 ship survey and 1991/92 aerial survey. Best estimates were based on the ship survey only if not available from the aerial survey or if aerial survey data were believed to be biased. Otherwise, best estimates were simple averages of ship and aerial estimates with coefficients of variation (CV) based on the sum of variance divided by 4.

current management regime because the OSP level is unknown for most species.

A new scheme governing the management of marine mammals under the MMPA has been proposed by NMFS. The proposed regime is currently being reviewed by Congress and may be subject to substantial changes. The NMFS proposal is based on the idea of setting an annual limit on the maximum potential biological removal (PBR) of individuals from a population. PBRs would be calculated based on a minimum abundance estimate, the estimated maximum net growth rate of the stock, and a recovery factor which would take into account the status of the population in relation to the Endangered Species Act or MMPA categories. Conservative default values would be used in cases where data on growth rate or status were unavail-

able or insufficient. The default values would be more conservative for populations that are thought to be endangered and for those of which there is uncertainty.

Based on the best available information, PBRs would be calculated from the following simple equation:

$$PBR = N_{min} * R_{MNPL} * F$$

where $N_{min}$ is the minimum abundance estimate and is obtained from either an actual count (as in the case of pinnipeds which haul out on land and are relatively easy to count) or from the lower 95 percent confidence interval for a statistically based population estimate (as in the case of most cetaceans which are much more difficult to count). Use of minimum abundance estimates for these calculations is conservative but may make clear the importance of more accurate population estimates.

$R_{MNPL}$ is the growth rate of the population at its maximum net productivity level. This is not known for most species, and therefore, conservative default values have been set ($R$=0.02 for cetaceans and manatees and $R$=0.06 for pinnipeds and sea otters).

$F$ is the safety factor based on the status of the population relative to the Endangered Species Act or MMPA categories. Again, a default value is provided if status is unknown (which is currently the state for most cetacean species).

$F$ = 0.1 for endangered species

$F$ = 0.5 for species or stocks with threatened, depleted, or unknown status (most stocks fall under this category)

$F$ = 1.0 for stocks at OSP

Under the new proposal, default values are available for $R$ and $F$; however, estimates of $N_{min}$ are required for all species. Also, it will be necessary to determine exactly what populations/stocks the new regime will be applied to for all species. For this reason, emphasis on determining population size and structure is placed in the review papers.

In determining stocks for management, it is useful to separate the concept of a "population" from the concept of a "management stock." A population is a natural biological subdivision of a species that is reproductively isolated from other populations. A management stock (or management unit) is an artificial subdivision of a species which is treated as a single unit from the perspective of management. The term "stock" has often been applied to both populations and management units. Ideally, management units or stocks would correspond to biological populations, but real-world constraints, such as international borders and other jurisdictional boundaries, often require that we define management units or stocks on the basis of other factors.

The review committee discussed the new management framework and several members asked whether further changes to the NMFS proposal had been made or were expected. Michael Tillman, NMFS Science and Research Director for the Southwest Region, giving a brief overview of the status of the new management regime, stated that the NMFS plan is now in the hands of Congressional committees and that he was not aware of any proposed changes. The opinion was generally expressed that, although details of the proposed management regime are likely to change, the basic elements are not likely to change.

Overview of SWFSC Research on Coastal Cetaceans

Barlow also gave an overview of the coastal cetacean research program at the SWFSC. The major impetus for this research has been the incidental take of cetaceans in two California fisheries: the set-gillnet fishery for halibut and angel sharks and the drift-gillnet fishery for swordfish and pelagic sharks. Under the 1988 amendments to the U.S. MMPA, incidental mortality of marine mammals in commercial fishing operations was authorized for the 5-year period 1988-1993. During this period, additional data were to be collected on the affected marine mammal species to provide a basis for future management decisions. Recent estimates of incidental mortality in U.S. west coast gillnet fisheries have been obtained through the NMFS observer program, which was initiated in 1990. In order to assess the impact of gillnet mortality on cetacean populations, new abundance estimates, including confidence limits, are necessary.

Coordinated ship and aerial surveys, using standard line-transect methods, were initiated in 1991 to estimate the abundance of all cetacean species in the region of the California gillnet fisheries. To evaluate the effect of seasonality on cetacean abundance, surveys were designed to cover both cold-water months of winter/spring (February-April) and warm-water months of summer/fall

(July-November). The survey periods were chosen based on climatic atlases of the California coast which show that, on average, March/April have the coldest, and September/October the warmest, sea surface temperatures. The NOAA research vessel *McArthur* was used to survey during the warm-water period of 1991. A twin-engine, turbo-prop DeHavilland Twin Otter airplane was used to survey during the cold-water period. Other earlier surveys were completed in 1979/80, and Barlow compared these estimates with those obtained during the 1991 survey to determine whether long-term changes had occurred in California's cetaceans.

Simultaneous to the above efforts to estimate population size, the Southwest Regional Office initiated a gillnet observer program to determine the level of cetacean bycatch in California's fisheries. Two papers were prepared by SWFSC staff which present estimates of cetacean mortality from this program.

Information relevant to marine mammal management is summarized in three status-of-stocks review papers for harbor porpoise, other odontocetes, and large whales. The harbor porpoise review also presents a new line-transect estimate of harbor porpoise abundance based on aerial surveys conducted in 1988-91. Information on the underlying population structure was reviewed for several small cetaceans in a separate paper.

Workshop participants commented that the format used by the SWFSC to review status of stocks was extremely useful and that future workshops in other NMFS regions should be planned and should follow a similar format. The panel concluded that three tasks must be accomplished for all population assessments where marine mammals are being exploited directly or indirectly:

1) Identification of the population's stock structure, estimation of the size of the population, estimation of mortality rates for the population, and an assessment of the rate of exploitation of that population.

2) Differentiation of populations using data on morphological, molecular genetic, distributional, life history, and pollutant differences, as well as with movement data from photo identification or tagging. The panel determined that the work conducted at the SWFSC is unique because all these approaches have been used in stock assessments, and the panel agreed that other NMFS regions should conduct assessments in the same way.

3) It should be required, not requested, that collection of data and specimens necessary to make stock assessments be taken from fisheries involved.

After the formal review of papers, the review panel continued to discuss specific aspects of the NMFS proposed management scheme. It was noted that the probability of a population being less than the lower 95th percentile of a two-tailed distribution (that is, a minimum population estimate) is only 2.5 percent. The group discussed the difficulties in estimating the extremes of a distribution and questioned whether the 95th percentile might refer to a one-tailed distribution. Although the opinions of the workshop participants on this subject are considered valid, the decision to use a specific value is not a scientific decision. It is a political judgment based on how conservative resource managers should be in the face of uncertainty. The group recommended that an additional workshop be held to discuss this issue as well as other issues pertaining to the particulars of the proposed management scheme.

The workshop participants generally recommended that the level of activity and priority of work on population and stock structure should be raised. This work should not be limited by regions or by the Exclusive Economic Zone; efforts should be made to expand the geographic range of sample collection. It was also recommended that the level of cooperation and coordination between NMFS regions be increased, in particular, the areas of abundance and mortality estimation. In addition, workshop participants agreed that more information is needed regarding cetacean populations and fishery interactions in foreign waters.

Throughout the workshop, there was obvious interest in population growth rates of harbor porpoise and, therefore, it was recommended that aerial surveys in central California be continued to estimate the growth rate of a harbor porpoise population over a 10-year time period (data are already available for 5 years). Because fishery mortality is no longer a problem for that population due to fishery closures, the harbor porpoise is expected to grow toward carrying capacity. It was also noted that the large discrepancies in recent estimates of blue whales were another obvious subject of interest and that additional work should be done to help resolve this controversy. (J. Sisson, (619) 546-7064

# HONOLULU LABORATORY

Honolulu, Hawaii

### Volume Completed on "Fisheries of Hawaii and U.S.-associated Pacific Islands"

The rapidly changing fisheries of the U.S. Pacific islands are well known in Hawaii and the central Pacific, but the availability of information has been generally limited to Fishery Council annual reports, agency administrative reports, and data reports. Nowhere is there a published source of reference information dealing with fisheries in this region. In late 1991, Laboratory Director George Boehlert organized a meeting of interested parties (and potential authors) at the Honolulu Laboratory to develop a volume of papers to address this shortcoming; participants agreed that papers summarizing the fisheries sector with up-to-date information otherwise available only in unpublished form would be quite useful. The scope of the volume of papers is limited to domestic island-based, rather than distant-water, fisheries, thereby excluding tuna purse-seine and albacore fisheries and island-based foreign fleets in the case of Guam and American Samoa. Each paper includes information on the biology of the species involved, a synopsis of the fishery (including historical trends, gear and vessel types, data sources and collection, status of stocks, and a brief description of markets), current research and research needs, issues associated with management and regulation of the fishery, and future prospects. It was agreed to have this volume published as a special issue of *Marine Fisheries Review*, with Boehlert serving as editor of the issue. It is anticipated that the volume will be published in late summer 1993, and copies will be made widely available. (G. Boehlert, [808] 943-1211)

## PROTECTED SPECIES INVESTIGATION

### Hawaiian Monk Seal Research Aids Mediterranean Monk Seal Plans

Angela Caltagirone of the National Park of Port-Cros, France, visited William Gilmartin, chief of the Protected Species Investigation, March 30-April 9, 1993, to discuss the feasibility of captive breeding of the Mediterranean monk seal, *Monachus monachus*, based on experience with the Hawaiian monk seal, *Monachus schauinslandi*. The Mediterranean monk seal is one of the most endangered animals in the world, with only 300-500 individuals remaining in the Mediterranean and on the Atlantic coast of North Africa. Little is known of the species, none are presently in captivity, and the number of animals in the wild continues to decline, in part due to declining habitat availability and continuing fishery interactions. Discussions between Caltagirone, Gilmartin, and the Marine Mammal Research Program staff dealt with seal collection and transport methods, captive facility requirements, reproduction, behavior, nutrition, hematology and blood chemistry, and genetics. Caltagirone's report will suggest initiating a captive breeding program and will be presented to the French Ministry of the Environment, which will review the report with an international panel. Gilmartin has been invited to attend this meeting. (W. Gilmartin, [808] 943-1239)

### Hawaiian Monk Seal Committee Meets

The Hawaiian Monk Seal Captive Care Committee convened on March 16, 1993, to consider several topics. The membership of this committee includes veterinarians and animal care experts; it reviews aspects of the health, maintenance, and quarantine of monk seals entered into temporary or permanent captivity by the Protected Species Investigation of the Honolulu Laboratory. The committee also reviews proposed experimental protocols for permanently captive seals.

Items on the March 16 agenda included proposed changes to the Health Care Guidelines, an update on relocation of rehabilitated captive seals to Kure Atoll, and review of two experimental protocols proposed by the University of Hawaii. The first protocol reviewed includes using deuterium oxide ($D_2O$) to determine total body water of captive seals. This method will provide calibration of a bioimpedance analyzer, which may prove to be a useful tool in determining the condition of emaciated seals brought into captivity for rehabilitation. The committee also reviewed the protocol for a study on semen quality of captive male seals that have been given a testosterone suppressant. (J. Henderson, [808] 943-1225)

## INSULAR RESOURCES INVESTIGATION

### Juvenile Snapper and Reef Fish Research Progresses in the Insular Ecology Program

Fishery Technician Denise Ellis recently completed Administrative Report H-93-03, "A comparison of baited video camera and Kali longline for indexing the abundance of juvenile opakapaka, *Pristipomoides filamentosus*," coauthored by Marine

Mammals and Endangered Species Program Leader Ed DeMartini. The report describes the results of field tests of sampling gear options for assessing juvenile snapper abundance, conducted during May 1992 on *Townsend Cromwell* cruise TC-92-04. The two general conclusions made in the report are as follows: (1) This particular situation, a direct (videographic) measure of abundance, provides more accurate estimates than the indirect sampler (longline) because of hook competition with nuisance species; and (2) video samples also seem to be more precise. Preliminary estimates of statistical power indicate that a reasonable (2- to 3-day) effort would be sufficient to detect temporal changes of about 50 percent in video index at one nursery area off Kaneohe Bay, windward Oahu. A revised version of the report is presently undergoing review prior to submission to *Fishery Bulletin*.

DeMartini also completed Administrative Report H-93-06, "Temporal changes in reef fish prey populations at French Frigate Shoals, Northwestern Hawaiian Islands: implications for juvenile monk seal, *Monachus schauinslandi*, predators." Coauthors of the report are Fishery Biologist Frank Parrish, also of the Honolulu Laboratory's Insular Resources Investigations, and James Parrish, Hawaii Cooperative Fishery Research Unit, U.S. Fish and Wildlife Service. The report's major conclusions are that available data are consistent with, but by themselves do not conclusively demonstrate, nontrivial declines in the standing stocks of shallow-reef fishes at French Frigate Shoals (FFS), Northwestern Hawaiian Islands (NWHI), between the early 1980s and 1992.

Reef fish standing stocks at FFS have potential importance as monk seal prey, particularly because of the recent declines in survivorship of juvenile monk seals at FFS. Analogous field surveys at Midway Atoll are scheduled for summer 1993. This atoll, farther upchain in the NWHI, has for the past year been the relocation site for previously starved, rehabilitated monk seals. An interdecadal comparison of reef fish abundances at Midway will contribute to the NMFS evaluation of Midway as a suitable relocation site. The Midway comparison also should allow a more general test of whether interdecadal changes in productivity have occurred in the NWHI. (E. DeMartini, [808] 943-1266.)

### Discussions Held on Cooperative U.S.-Japan Seamount Research

Discussions on seamount research were held March 15-17 at the Honolulu Laboratory with Takashi Sasaki and Takashi Yanagimoto of the National Research Institute of Far Seas Fisheries, Shimizu, Japan. Honolulu Laboratory personnel involved in the discussion included Director George Boehlert, Insular Resources Investigation Chief Jeffrey Polovina, and Fishery Biologist Robert L. Humphreys, Jr. Sasaki presented information indicating that the 1992 armorhead trawl catches have significantly increased at Southern Emperor-Northern Hawaiian Ridge Seamounts outside the U.S. Exclusive Economic Zone (EEZ). Japanese bottom trawlers had previously experienced low annual catches of armorhead since the sharp post-1976 decline in the seamount fishery. Complete catch-and-effort statistics for the 1992 seamount trawl fishery outside the EEZ are expected to become available later this year; currently the 1992 effort, and therefore the trawl CPUE, are unavailable. The upsurge in catches outside the EEZ is currently thought to have been caused by a large recruitment of armorhead to these seamounts. Of particular interest is whether the armorhead population at Hancock Seamounts (within the EEZ) has increased; the annual armorhead stock assessment cruise to Hancock was not conducted in 1992. Sasaki and Yanagimoto discussed plans for an armorhead research cruise to the seamounts during October-November 1993. Their preliminary cruise itinerary includes surveys of armorhead abundance and sample collections at all of the major Southern Emperor-Northern Hawaiian Ridge Seamounts outside the EEZ. Since a National Marine Fisheries Service armorhead assessment cruise to Hancock is scheduled for October 1993, talks encompassed both collaborative work on armorhead and possible joint sea operations. Preliminary collaborative plans include an exchange of scientists at sea to observe operations aboard each of the research vessels, exchange of biological samples, and exchange of all biological and catch data collected during each cruise. (R. Humphreys, [808] 943-1229)

### Bottomfish Catch-and-effort Data Evaluated

Honolulu Laboratory staff have been evaluating bottomfish catch-and-effort data for preparation of the annual status-of-stocks report required in the Fishery Management Plan (FMP). This fishery mainly involves several species of deep-slope snappers and jacks and a single species of grouper. The Hawaiian Islands have been divided into three bottomfish management zones (Fig. 1). In the main (inhabited) Hawaiian islands (MHI) bottomfish stocks are fished both commercially and recreationally without federal restrictions. The Northwestern Hawaiian islands (NWHI) are uninhabited and

range from 150 to 1,200 nautical miles from port, essentially limiting this region to commercial fishing effort. The NWHI are divided into two management zones. The closer Mau Zone requires a federal license to fish but is currently not limited to any particular number of vessels. It is used as a qualifying zone for entry into the second limited-entry zone, the Ho'omalu, which is farther from Hawaiian ports.

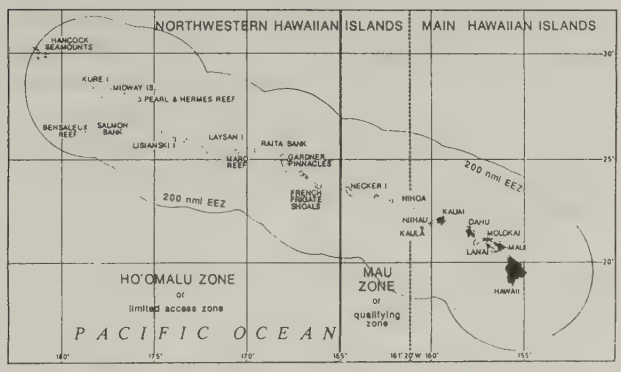


Figure 1. U.S. Exclusive Economic Zone of the Hawaiian Islands, showing the Northwestern Hawaiian Islands' two management zones west of 161°20' W: the Ho'omalu Zone (limited access zone) and the Mau Zone (qualifying zone).

Data evaluated for each zone include species composition of the catch, catch-per-unit effort (CPUE), percent of immature fish in the catch, mean weight by species, and spawning potential ratio (SPR). SPR is equal to the current (fished) spawning biomass divided by the initial (unfished) biomass. The time series of data for the NWHI zones begins in 1984, while that for the MHI begins in 1948 for some indices. All indicators suggest that NWHI stocks are healthy, whereas MHI stocks are heavily exploited. Species with SPR values of 0.20 and less have been defined as recruitment overfished in the FMP. Two species, onaga, *Etelis coruscans*, and white ulua, *Caranx ignobilis*, have had MHI SPR values below this level, and SPR values for several other species are close to this level.

It should be emphasized that the lack of data on MHI recreational effort and landings and the multispecies nature of the fishery impose limits on reliable SPR estimation. The current methodology uses a species-aggregated CPUE time series and species-specific percent immature in the catch. Alternative methodologies for SPR estimation are being explored although preliminary findings are generally consistent with the CPUE-based approach.

Don Kobayashi, Honolulu Laboratory fishery biologist, recently reevaluated the giant trevally's, *Caranx ignobilis*, SPR value in Administrative Report H-93-02. In his report, Kobayashi suggests that the method used to calculate SPR in the past is not appropriate for this species because of its unique dual fishery situation. Young jacks within a narrow size range are caught by net prior to entering the more typical bottomfish hook-and-line fishery. The pulse of small fish significantly alters the size-frequency distribution of the catch sampled at the Honolulu auction, leading to erroneous SPR calculations. Kobayashi suggests that MHI SPR values are more likely to be around 0.80 than at 0.20 for this species.

Application of a dynamic production model to the short time series of NWHI data resulted in an estimate of maximum sustainable yield (MSY) of about 800,000 pounds of bottomfish from both management zones, with an estimated effort of 1,000 fishing days. The total MSY for the two zones can be partitioned according to the percentage of bottomfish habitat available within the two zones. The Mau Zone contains 24 percent of the total bottomfish habitat area and the Ho'omalu Zone 76 percent. Assuming that bottomfish resources are evenly distributed between zones results in estimates of MSY and effort of 192,000 pounds, 240 fishing days for the Mau Zone and 608,000 pounds, 760 fishing days for the Ho'omalu Zone. (R. Moffitt, [808] 943-1244).

## Prototype Gear Field-tested for Capturing Pelagic Juvenile Marine Turtles in Surface Convergence Zones

The pelagic development stage for all threatened and endangered species of sea turtles, often referred to as the "lost years," which begins shortly after newly hatched turtles enter the sea and continues until they recruit to coastal waters as subadults, is poorly documented and understood. Many sea turtle biologists support the hypothesis that driftlines formed by advection and downwelling are almost certainly where juvenile pelagic marine turtles live and feed; however, with few exceptions, efforts to locate and capture juvenile pelagic marine turtles for research have not been successful. To effectively sample driftlines, a prototype gear was constructed with funding from the NOAA Marine Entanglement Research Program and field-tested during sea trials by the NOAA ship *Townsend Cromwell* prior to cruise TC-92-10 (Fig. 2). The gear consists of a modified trawl and floating door, and it is designed to overcome the avoidance capabilities of juvenile pelagic marine turtles for surface-towed

sampling gear; samples could also be used to assess the presence of marine debris potentially harmful to animals foraging in convergence zones.

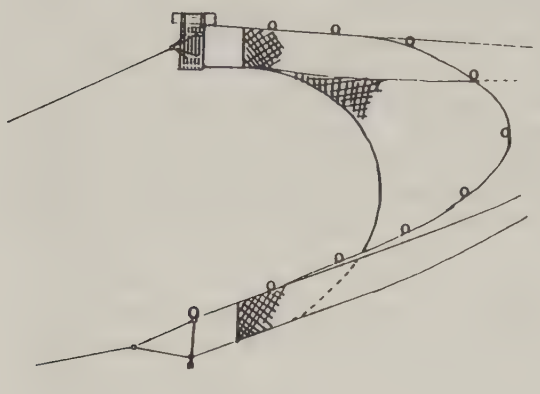

Figure 2. Diagram of mouth opening of the modified 12.50-m (41-ft) Gulf of Mexico flat shrimp trawl.

The net is towed from *Townsend Cromwell*'s starboard A-frame as a non-rigid floating net with a single paravane, or door, to spread the outboard wing of the net with the inboard wing secured to the vessel. A net with a rigid frame similar to those used on beam trawls was considered and rejected as being too unwieldy and too dangerous to handle in the confined work area around *Townsend Cromwell*'s A-frame. A rigid net frame would also require the installation of a large towing boom.

The prototype net is a modified Gulf of Mexico flat shrimp trawl with a 12.50-m (41-ft) headrope and 13.11-m (43-ft) footrope. The footrope, with tickler chain and headrope floats, was removed, and the net was reversed so that the original headrope became the footrope. The new top panel (bottom panel of original net) was cut back, and nine floats were attached to a new 14.63-m (48-ft) headrope to enable the footrope to lead the floating headrope when towed. The idea is to have the footrope pass unnoticed under juvenile pelagic turtles on the surface and to prevent their escape as they dive to avoid the trailing headrope. All cod-end and chafing gear were also removed to minimize drag. A large door was specially designed. Tows were conducted at speeds of 2-4 knots from *Townsend Cromwell*'s A-frame, located amidships on the starboard side. At 4 knots and a towing angle of 45 degrees on the door, a net spread of 5-6 m (16-20 ft)was attained with the inboard wing being about 5 m (16 ft) off the starboard side.

The performance of the gear was promising. The door was very stable on the surface, and the 5-6–m (16-20 ft) net spread attained at 4 knots is encouraging considering that only a single door is used. Although the minimum size net opening that would be effective in capturing juvenile pelagic turtles is unknown, improvements to reduce net drag and increase the net spread will be explored further. On future tows, a floating cage will be attached to the cod-end, enabling captured turtles to breathe. Whether this gear design is effective will not be known until sea trials in convergence zones are conducted and juvenile pelagic turtles captured. (P. Shiota, [808] 943-1236)

## PELAGIC RESOURCES INVESTIGATION

### Strategic Plan Being Developed for Honolulu Laboratory Pelagics Research

Fishery managers in NMFS and the Western Pacific Regional Fishery Management Council (WPRFMC) face several new challenges with respect to tuna and billfish fisheries. First, U.S. jurisdiction has recently been extended to cover the harvest of tuna species within our 200-mile EEZ, in addition to billfish and other highly migratory species. Second, in Hawaii, significant longline fisheries for swordfish and bigeye tuna have developed, yet little is known about the dynamics of the exploited populations. Third, the Hawaiian longline fisheries incidentally take species targeted by local troll and handline fisheries, such as yellowfin tuna and blue marlin. Trollers and handliners are concerned about the effects of longline fisheries on their catch rates and overall stock levels. Finally, the fleets in Hawaii, and also those in American Samoa, Guam, and the Northern Mariana Islands, are anxious about local impacts arising from increasing catches of tuna and billfish in adjacent international waters by multinational fleets of longliners and purse seiners.

In response to longline fishery expansion in Hawaii, the WPRFMC has temporarily limited the number of longline fishing permits and restricted longlining to waters outside the nearshore fishing grounds frequented by trollers and handliners. In adopting these measures, the Council weighed the best information available and recognized there was considerable uncertainty about the structure and dynamics of the fish stocks and the magnitude

of fishery interactions. Reducing this uncertainty and minimizing the risk of wrong decisions clearly will require a substantial research effort on the part of NMFS Honolulu Laboratory and others. Base budget support of pelagics research, however, has not kept pace with the demand for information. In order to assure that the most critical information needs are met with a limited budget, changes to the research agenda are needed.

To improve the effectiveness of its pelagics research, the Honolulu Laboratory is developing a new strategic plan on this topic. The purpose of the plan is to describe the principal fishery management issues and decision criteria, identify information needs, set appropriate research goals and objectives, and describe research strategies that will achieve the objectives. A draft plan has been assembled internally under the leadership of Robert A. Skillman, leader of the Pelagic Stock Assessment Program, and is now under review. The plan details research strategies to achieve objectives in fishery monitoring, stock assessment and management analysis and to provide biological, economic, and oceanographic data required for improved models. The plan shows which parts of the research strategy can be implemented with current internal NMFS funding and which components remain unfunded. Possibilities of funding research projects through external sources (for example, the University of Hawaii's Pelagic Fisheries Research Program) are also described. The next step will be to establish a practical implementation plan consistent with available resources.

The Honolulu Laboratory plan, though developed internally, explicitly recognizes the need for collaboration with other pelagic research groups, both within NMFS and elsewhere in the Pacific. Accordingly, it identifies areas where more effective research can be done through cooperation with other laboratories. The Honolulu Laboratory plan provides a basis for addressing local issues in the context of a broader research plan for the Southwest Fisheries Science Center. (J. Wetherall, [808] 943-1258)

### Visiting Scientist Discusses Shark Research and Acoustic Tagging Methodology

A. Peter Klimley of the Bodega Marine Laboratory, University of California at Davis, visited the Honolulu Laboratory in March and presented two seminars on his shark research. Interest in sharks is high in Hawaii because of recent problems with tiger sharks, and Honolulu staff researchers are particularly interested in Klimley's work with archival tags for use in monitoring behavior of large pelagic fishes.

One seminar concerned Klimley's visual monitoring of white sharks feeding on elephant seals and sea lions. Analysis of the sequence and timing of predatory behaviors indicated that in successful attacks, prey were killed in the initial encounter by being bitten (usually in the head) and held underwater where they bled to death. "Bite and spit" behavior was not normally observed, and Klimley suggested that this behavior occurs mostly with unpalatable prey. Prey capable of striking the shark (for example, elephant seals) were most likely to be seen alive after the initial encounter.

The other seminar concerned movement patterns in scalloped hammerhead sharks. Klimley described a system of individually coded acoustic tags and moored receivers that automatically record the behavior of sharks around a seamount where hammerheads tend to aggregate at certain times of day. Arrivals and departures of many identified individuals were tracked to show coordinated behavior. The paths taken by sharks to and from the seamount were also tracked, and Klimley's analysis suggests that hammerhead sharks use contours of magnetic field topography for guidance.

Klimley has proposed to use moored receivers and acoustic tags to record residence time, departure, and return of tuna to fish aggregating devices in Hawaii. Honolulu Laboratory personnel discussed development of archival tags with Klimley, who has received funding to further develop this technology. Current archival tags store information such as depth, temperature, and light intensity. Light intensity data are used to estimate local noon and day length to provide a sequence of low-resolution geographic position (a track line) when an animal ranges over a very broad area (hundreds of miles). Existing archival tag technology requires physical recovery of the tag to retrieve the data. Klimley hopes to adapt his acoustic tag and moored receiver system for use with an advanced archival tag that would acoustically download stored data whenever a tagged animal comes near a receiver. He also hopes to improve archival tag position estimation through incorporation of extinction coefficients (to quantify signal attenuation versus distance from source in the onboard microprocessing) and through use of magnetic sensors. (C. Boggs, [808] 943-1222)

# PELAGIC FISHERIES RESOURCES DIVISION

La Jolla, California

### SPAR 5 and South Pacific Tuna Treaty Meetings Held

The fifth meeting of the South Pacific Albacore Research (SPAR) Group was held in Papeete, French Polynesia, during March 29-April 2. The staff of the Southwest Fisheries Science Center (SWFSC) submitted three working documents for the meeting: (1) "Summary of the 1990-91 U.S. South Pacific albacore fisheries data" by G. Rensink, (2) "Report of SWFSC research activities for South Pacific albacore during 1991-92 and plans for 1993" by SWFSC staff, and (3) "Reproductive patterns of South Pacific albacore, *Thunnus alalunga*, as indicated by gonosomatic index and meiotic activity" by SWFSC Fishery Biologist Darlene Ramon and Kevin Bailey, previously with the South Pacific Commission. These documents along with others submitted by scientists from American Samoa, Australia, Cook Islands, Fiji, French Polynesia, Japan, New Caledonia, New Zealand, Solomon Islands, Taiwan, Tonga, and the South Pacific Commission formed the basis for an evaluation of fisheries results and condition of the stock by the Group.

Fisheries statistics reviewed at the meeting indicated that in 1992, the surface fishery caught an estimated 7,300 t of albacore from the South Pacific. This catch was well below the peak taken in 1989 (31,000 t) and the lowest catch for this fishery since 1987. Statistics for the 1992 longline fishery were not available; however, statistics for 1991, which indicated a total catch of 21,700 t, and anecdotal information on the 1992 fishery indicated that the 1992 catch was either the same as in 1991 or lower.

The Group reviewed the performance of the fisheries, trends in catch rates, and biological information to determine the condition of the stock. It concluded that since the moratorium on driftnet fishing went into effect in 1990-91, catches of South Pacific albacore have remained near or below their historical average. There is no evidence from the available stock abundance indicators that current levels of fishing are adversely affecting the stock. However, because the time series of abundance indicators is short and provides imprecise information on trends for recent years, the Group advised that rapid expansion in the catch not be encouraged at this time. (G. Sakagawa, [619] 546-7177)

## STOCK ASSESSMENT AND FISHERY IMPACT ANALYSIS PROGRAM

### Albacore Ovary Preservation Effects Studied

Fishery Biologist Darlene Ramon recently examined albacore ovaries to compare the effects of preservation by freezing versus preservation by using formalin. Samples were collected from various locations in the North and South Pacific as part of a larger study on reproductive maturity of albacore. The ovaries were examined for differences in weight and oocyte diameter.

To assess the effect of formalin on ovary weights, samples were first weighed fresh, then placed in formalin for 1 to 3 months before being reweighed. Using Student's t-test, a significant difference between weight of fresh- and formalin-preserved samples was indicated ($t$=3.58, $P$<0.05, $df$=61). The same process of taking a fresh weight and reweighing the ovary was also done for samples that were frozen. This resulted in a significant difference between fresh samples versus frozen samples ($t$=6.96, $P$<0.05, $df$=14). These results were then applied to investigate what type of error is introduced by using preserved weight to calculate the gonosomatic index.

The effect of preservation on oocyte diameters was also examined. Samples were available from the North Pacific jigboat fishery and from Hawaii. When obtained, one side of each ovary was frozen and the other side preserved in formalin. The mean diameters of the twenty largest oocytes from a section of each side of the ovary were measured to the nearest micron. Samples were examined for differences resulting from preservation type. A significant level of difference was found to exist between the mean of the most advanced group of oocytes for the two sides ($P$<0.05). A control group for which both sides of the ovary were preserved in formalin exhibited no significant differences ($P$>0.05). (D. Ramon, [619] 546-7074)

### Results of Angler Survey Reported in 1993 Billfish Newsletter

The "1993 Billfish Newsletter" will be distributed in June 1993. The newsletter is an annual publication produced by the Southwest Fisheries Science Center as a service to the U.S. angling community. Its emphasis is on billfish-angling results in the Pacific and Indian Oceans. The data used are from the 1991 Pacific Billfish Angler Survey which fol-

lows the trends in fishing in terms of catch rates for the recreational fishery. A summary of the information in the newsletter is as follows:

> In 1991, the total number of billfish fishing days in the Pacific and Indian Oceans reported by those anglers responding to the Survey was 8,185, approximately one-half of the effort reported in 1990. Anglers responding to the Survey reported catching 4,694 billfish in the Pacific. The catch rate for the Pacific was 0.57 billfish/day or 1.7 days/billfish. This is about a 35 percent increase in catch rate from 1990, indicating better overall fishing.
>
> In Southern California, anglers reported 2,107 days of fishing, about one-third less than in the previous year. The catch rate for striped marlin, measured as numbers of fish per day, was 0.06, which is about one-half the rate experienced in 1990. Other areas, including Baja California (striped marlin) and Acapulco, Mexico (sailfish), also reported lower catch rates.
>
> In contrast, many areas reported significantly higher catch rates, including Hawaii (blue marlin), Tahiti (blue marlin), New Zealand (striped marlin), and Costa Rica (sailfish).

The 1992 Angler Survey will be included with the mailing of this year's "Billfish Newsletter." (N. Bartoo, [619] 546-7073)

## MULTISPECIES DATA COLLECTION AND EVALUATION PROGRAM

### Presentations Made at Tuna Conference

The Multispecies Data Collection and Evaluation Program presented one paper and three posters at the 44th Tuna Conference which was held at Lake Arrowhead, California, on May 17-20, 1993.

In his paper, "North Pacific albacore length-frequency data: Is there a bias due to the release of small fish at sea?," Fishery Biologist Gary Rensink reported on situations where small albacore are not consistently retained in the catch and are discarded at sea. For the study on which the paper is based, North Pacific albacore length-frequency port sample data were grouped into time periods (1961-75, 1976-79, 1980-83, and 1984-92). Trends in landings of small albacore (<9 lb) were examined. Results show that the percentage of small albacore landed per trip did not change significantly between time periods. However, the percentage of landings containing less than 2 percent small albacore did change significantly between time periods. Observer data collected since 1990 show that there may be a difference between percentages of small albacore landed depending on whether vessels kept or released small albacore. (G. Rensink, [619] 456-7192)

Mathematical Statistician Atilio L. Coan's poster, titled "Substitution of length-frequency samples between sampled and unsampled strata," showed how he analyzed length-frequency data collected from the U.S. purse-seine fleet fishing in the southwestern Pacific in 1989 and 1990. Results indicate significant differences in length frequencies between month/area. Consequently, Coan showed that substituting data from one stratum for another is not advisable in reconstructing the size composition of the catch when length-frequency data for all catch strata are unavailable. (A. Coan, [619] 546-7079)

Fishery Biologist Alan Jackson's poster, titled "Bycatch of tuna in the California drift-gillnet fishery," summarized data collected on the amounts of albacore tuna, yellowfin tuna, skipjack tuna, and bluefin tuna taken in the California drift-gillnet fishery. The data were collected by NMFS observers aboard drift-gillnet vessels from April 1990 to March 1993. A total of 62 albacore tuna were recorded in 1990-91, 307 in 1991-92, and 1,071 in 1992-93. For bluefin tuna, the number of fish recorded by the observers ranged from 25 caught in 1991-92 to 131 caught in 1992-93. For skipjack tuna, the number of observed fish caught ranged from 40 in 1990-91 to 392 in 1991-92. The number of yellowfin tuna caught ranged from a single fish in 1990-91 to 38 in 1991-92. (A. Jackson, [619] 546-7048)

In the third poster paper, Biological Technician Randal Rasmussen's "Effects of the 1990 dolphin-safe policy on the U.S. eastern tropical Pacific tuna purse-seine fishery," Rasmussen examined data collected by NMFS observers aboard U.S. purse seiners fishing in the eastern tropical Pacific and compared fishing before and after adoption of a "dolphin-safe" policy by U.S. tuna canners in 1990. Results showed an increase in schooling and flotsam-associated tuna sets and a decline in porpoise sets, porpoise mortality, kill-per-set, and kill-per-ton. (R. Rasmussen, [619] 456-7184)

# TIBURON LABORATORY

Tiburon, California

## GROUNDFISH COMMUNITIES INVESTIGATION

### Sablefish Feed in Midwater and Benthic Mode

Fishery Biologists Thomas Laidig and Peter Adams of the Groundfish Communities Investigation have been studying sablefish diet as part of a larger ecological study of the slope community.

They found that the prey in the sablefish stomachs came from both the water column and the benthos. They discovered a mixture of water-column prey consisting of heteropods, thaliaceans, cephalopods, euphausiids, and midwater fishes; and bottom prey consisting of gastropods, crabs, echinoderms, and bottom fishes. Overall, the water-column prey occurred more frequently than the benthic prey (77 percent versus 52 percent). The sablefish showed a decreasingly significant trend of feeding on midwater prey with increasing sablefish length while feeding on benthic prey showed no trend with fish size. This midwater feeding mode accounts for the sablefish taken as bycatch in the midwater whiting fishery.

The decline in midwater feeding with size would result in a differential availability of sablefish of different sizes to bottom trawl gear. Since at any given time, a larger proportion of smaller fish may be in midwater feeding, bottom trawl estimates would be biased for larger fish. It is difficult to assess from stomach data how large an impact this trend would have, but the difference in frequency of occurrence of midwater prey is substantial and is comparable to the levels of differential availability to trawl gear due to diurnal behavior reported for other species in the northeastern Atlantic. Differential availability is likely to bias analyses based on relative abundance at size or age. (P. Adams, [415] 435-3149)

### Early Occurrence of Juvenile Rockfish Found in Predator Stomachs

Fishery Biologists Kelly Silberberg and Peter Adams of the Groundfish Communities Investigation have been monitoring the occurrence of juvenile rockfish in predator stomachs since 1980, for use as a predictor of year-class strength. Juvenile rockfish were found in king salmon stomachs on April 27, putting the 1993 juvenile rockfish year-class in a group of early occurrence years. The 1993 year-class is in a group of 4 years in which juvenile rockfish appeared in salmon stomachs earlier than the typical first occurrence period of mid-May. This group includes both weak and strong year-classes. Juvenile rockfish were also smaller than typical, with five stripetail rockfish, *Sebastes saxicola*, averaging 29 mm, and one shortbelly rockfish, *Sebastes jordani*, measuring 42 mm. (P. Adams, [415] 435-3149)

## GROUNDFISH PHYSIOLOGICAL ECOLOGY INVESTIGATION

### Collection of Shortbelly Rockfish Successfully Completed

A research cruise to collect adult and larval shortbelly rockfish, *Sebastes jordani*, was recently completed by investigators at the Tiburon Laboratory. The cruise aboard the NOAA ship *David Starr Jordan* began from the Monterey Coast Guard facility on February 17 and ended on February 27, 1993, at San Francisco. The investigators' main objective was to collect recently spawned shortbelly rockfish larvae and adults which represented the spawning populations. These samples will be used to determine whether the spawning biomass of shortbelly rockfish can be estimated using a modification of the egg production method.

Twenty-nine bongo tows were completed from the Monterey area and approximately 500 shortbelly rockfish larvae were isolated at sea, then frozen for later analysis. A total of nine trawls for adult *Sebastes jordani* was completed and 321 shortbelly rockfish were randomly sampled for length, sex, and gonadal development. Adults were located between 30 and 70 m off the bottom during the night, and dense aggregations were noted on the bottom during daylight hours. In addition to these samples, oceanographic data including sea-surface temperature, current profiles, and vertical temperature and salinity profiles were recorded over the survey area.

An additional 29 bongo tows were accomplished in the Bodega Canyon area, where a surprising abundance of shortbelly larvae was evident. Approximately 800 shortbelly larvae were sorted and frozen at sea from these tows. A significant number of these larvae were noted to have their yolk sacs attached, indicating recent parturition. Since the Bodega Canyon has received less attention from

rockfish surveys in the past, the abundance of shortbelly rockfish noted on this cruise may be of interest in future investigations of rockfish populations.

Later larval stages and juvenile shortbelly rockfish are to be collected in subsequent research cruises this year to complete a spatial-temporal assessment of physiological condition within a year-class. Physiological condition during this critical life stage of development can lead to a better understanding of potential growth and probability of survival. (M. Bowers, [415] 435-3149)

### Water Circulation at Cordell Bank Appears Conducive to the Retention of Rockfish Larvae

Cordell Bank, situated 37 km west of Pt. Reyes, California, shares a common attribute with many marine banks on continental shelves: high biomass and biological productivity. This is partially a result of structural prominence, creating an oasis effect in an otherwise featureless expanse of the continental shelf. But, also, the circulation of oceanic and coastal water masses about the bank may create conditions favorable to the retention of fish larvae from the resident spawning populations.

Tiburon scientists have studied the yellowtail rockfish, *Sebastes flavidus*, population at Cordell Bank since 1985. This population is geographically isolated from other yellowtail rockfish stocks. Research indicates that yellowtail rockfish tend to remain in restricted locales and do not migrate or otherwise distribute to areas removed from their home sites. The scientists hypothesize that the stock at Cordell Bank is maintained largely from the progeny of the resident adult population, with only minor contributions from immigrants.

To investigate the contention that water motion over the bank is conducive to larval retention, the scientists have measured the circulation pattern at Cordell Bank on four occasions using the acoustic Doppler current profiler (ADCP) aboard the NOAA ship *David Starr Jordan*. The ADCP data were collected along four transects of the bank. The transects were organized to traverse the short axis of the bank, which is an ovate (egg-shaped) structure approximately 15 km long and 8 km wide on the edge of the continental shelf. The mean depth is about 60 m and the base is situated on the shelf, where the inshore depth is about 110 m. The most recent surveys were conducted on February 24 and 26, 1993, in conjunction with sampling efforts for pregnant *S. flavidus*. Both surveys indicated that water velocities over the bank were lower than in the area surrounding the bank. This was particularly the case in the water column just above the bank. The ADCP recorded essentially calm water up to 10 to 30 m above the substrate. Surface velocities were on the order of 10 to 30 cm/second over the bank and up to 50 cm/second in the upper 20 m of water off the bank. On February 24, the current direction of the surface layer was northward. This was probably the result of sustained southerly winds in excess of 25 knots, which had blown for more than two weeks preceding this date. Due to the strong forcing factor of the wind's speed, it was surprising that water velocities just above the bank were calm or low relative to surrounding areas. By February 26, the winds had subsided. Consequently, surface flows were reduced. In the upper 20 m of water, velocities were approximately 5 to 15 cm/second at all stations, including those off the bank over the shelf and slope. Water velocity in the water column just above the bank top was very low or nonexistent during the previous two surveys conducted in other seasons (June 1992 and September 1991) as well.

These preliminary results indicate that the circulation on Cordell Bank is conducive to the retention of larvae spawned from yellowtail rockfish residing at the bank. This is supported by the results of surveys assessing the abundance of juvenile yellowtail rockfish. For example, during the May-June 1989 survey in the area from Monterey to Bodega, 50 percent (26/52) of the yellowtails were obtained from seven tows at Cordell Bank; the rest were collected from 100 tows distributed between Monterey and Bodega. (B. MacFarlane, [415] 435-3149)

## GROUNDFISH ANALYSIS INVESTIGATION

### Late Larval Rockfish Survey Completed

A research cruise (DSJ-93-04) aboard the NOAA R/V *David Starr Jordan* was conducted by staff members of the Groundfish Analysis Task at the Tiburon Laboratory from March 2-13, 1993. This particular survey was designed to study the distribution and abundance of pelagic-staged late larval rockfish, *Sebastes* spp., in an attempt to identify factors contributing to variability in annual spawning success. A similar survey was conducted in March 1992. Coastal waters off the central California coast from Monterey Bay (36° N) to Salt Point (38°35′ N), and out 200 nmi (127° W), were surveyed.

A rigid-framed Methot-Isaacs-Kidd (MIK) trawl (5-$m^2$ opening, 2-mm mesh and 0.505-mm codend)

was deployed at night to capture rockfish (8-25 mm standard length) at 55 different stations. At each station, an oblique tow was made with 200 m of wire out, which produced a maximum fishing depth of 50 m. Ten additional tows were made with 400 m of wire out. The net was towed at 3 knots for 30 or 60 minutes, depending on the amount of wire out. Once landed, all rockfish were enumerated, with shortbelly rockfish, *S. jordani*, and bocaccio, *S. paucispinis*, identified as to species. A plot of the total rockfish catch from the 55 standard tows (Fig. 1) reveals generally low abundance in offshore waters, a few large catches that were taken nearshore, and a center of abundance within an offshore warm eddy-like feature in the southern portion of the survey area. Overall, these late larval rockfish were not as abundant as in 1992.

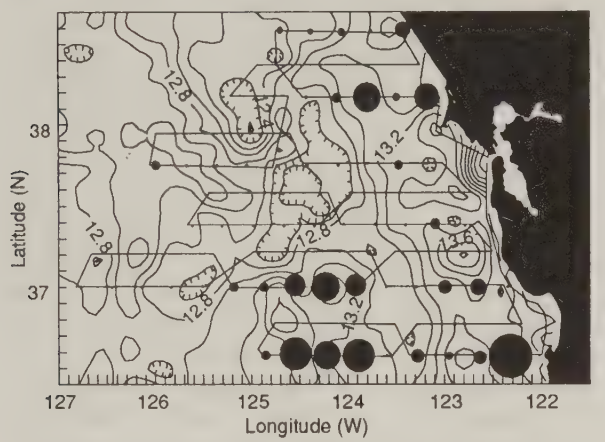


Figure 1. Contours of sea-surface temperature and the catch of late-larval rockfish taken during DSJ-93-04. Circles represent catch data, size is proportional to catch rate; range of catch = 0-311 rockfish. Straight lines depict the cruise track. Contours with hatch marks represent cooler waters; contours without hatch marks represent warmer waters—those near longitude 124 and 125 are possible eddys. Curved lines near bay are plumes.

Sea-surface temperatures (SST) and salinities were recorded continuously during the cruise. Figure 1 shows generally above-average SSTs for March. Also shown are the San Francisco Bay plume and a possible warm eddy along the southern edge of the survey area. Warm water appears to have persisted in the region from last year's El Niño, but this year it is not as spatially extensive. Even so, numerous pelagic red crabs, a southerly distributed species, were captured.

Additional oceanographic data were collected. Over 100 conductivity-temperature-depth casts were completed, mostly during the day along track lines paralleling those at night. Although the SSTs were above normal again this year, the thermocline was not as deep as observed in 1992. Ocean currents were also recorded with an acoustic Doppler current profiler, but these data have not yet been analyzed. (D. Woodbury, [415] 435-3149)

# INFORMATION TECHNOLOGY SERVICES

### IT-95 System Procurement in Final Phase—Winning Vendor to be Announced

NMFS' Source Selection Advisory Board (SSAB) met with the NOAA attorney and procurement officers on April 5, 1993, at Silver Spring, Maryland, to review the Best and Final Offer by the vendors and the assessment report from the Technical Advisory Committee (TAC) on the vendors' IT-95 systems proposals. On the SSAB are the Regional Data Base Administrators Eugene Heyerdahl (Northeast Center), MaryAnne Treadway Camp (Southeast Center), Ted Rodgers (Alaska Center), John Landahl (Northwest Center), Dorothy Roll (Southwest Center), and Headquarter's representative Michael Fraser.

The assessment report, presented by TAC chairperson and IT-95 Project Manager Hugh Johnson, documented the technical and cost evaluations of the proposals and the final consensus rating of the vendors by the TAC members. Don Tieman represented the Southwest Regional area on the TAC. In the assessment report, the TAC recommended that the vendor be selected based on best value, not lowest cost, and the SSAB members unanimously endorsed the recommendation. On April 8, Fraser and Johnson briefed Nancy Foster, acting assistant administrator for Fisheries, on the recommendations. On April 12, a decision meeting was held with Diana Josephson, the acting NOAA source selection official for the IT-95 procurement, and she approved the vendor recommended by the SSAB.

The contract will be awarded upon completion of several remaining routine clearances. At that time, the name of the vendor will be announced. If there are no protests, the deliveries to the three mandatory sites (Seattle, Miami, and Silver Spring) will begin in late summer. (D. Roll, [619] 546-7057)

### DOC/NOAA to Issue Software Policy

The March 1993 issue of NOAA's Information Technology Bulletin announced that the Department of Commerce (DOC) Information Technology (IT) Management Handbook is being revised to include a new section, "IT Security Management." Chapter 13 of the handbook will address the departmental policy on copyright violations. To be published at the same time is a revised IT Security Manual, a companion document, which will give guidelines for implementing the policies and regulations. Line Offices will be instructed to comply with the licensing agreements issued by the manufacturer for software purchased by the government.

The alert to be proactive in implementing the NMFS software policy was issued to the staff by Michael Tillman, the Deputy Assistant Administrator for Fisheries. During the National Data Management Meeting, held in conjunction with the Source Selection Advisory Board meeting, the members discussed the ADP Security and illegal software issues in reference to NMFS compliance with the DOC/NOAA policy. In response to Tillman's request, the committee developed recommendations for an updated NMFS policy. The recommendations for the update include a firmly worded policy statement from NMFS Headquarters as well as recommendations for the education of users, up-to-date software inventory, and periodic audits of the LANs and users' PCs in order to maintain compliance with the licensing agreements. A policy statement is being drafted for review and approval. Penny Baile, of NOAA Labor Relations, advised that the policy state that violations will be subject to disciplinary action, with actions ranging from reprimand to suspension or removal, depending on the circumstances of the case.

In response to DOC's alert on computer security issues, the La Jolla Laboratory's Software Policy Committee was formed in late January to conduct a software inventory, update the software for compliance with copyright agreements, and develop Center-wide procedures for conformance to NMFS updated policy. Committee members are SWFSC's Rich Charter (leader of the Coastal and Pacific Fisheries Resources Investigations in the Coastal Division), Al Coan (leader of the Multispecies Data Collection and Evaluation Program in the Pelagic Fisheries Resources Division), Bob Holland (computer programmer in the Marine Mammal Division), and Information Technology Services Chief Dorothy Roll (also chairperson of the Software Policy Committee), Computer Specialist Frank Ralston, and Electronics Technician Matt Bones. (D. Roll, [619] 546-7057)

## PUBLICATIONS

### Published


Atkinson, S., W. G. Gilmartin, and B. L. Lasley. 1993. Testosterone response to a gonadotrophin-releasing hormone agonist in Hawaiian monk seals, *Monachus schauinslandi*. J. Reprod. Fert. 97:35-38.

Adult male Hawaiian monk seals were administered a gonadotrophin-releasing hormone (GnRH) agonist to determine its effectiveness in reducing the testicular production of testosterone. Blood samples were collected from four treated seals and two control seals at weekly intervals for 10 weeks and again at the beginning of the following breeding season. The GnRH-agonist had an initial, brief, stimulating effect on circulating testosterone, but this was followed by an inhibitory effect that lasted for 7 to 8 weeks. The plasma concentrations of testosterone were within normal ranges by the following spring. These results demonstrate a reversible form of long-term androgen suppression, which may have applicability in a variety of wildlife management programmes.

Bailey, K. M., R. D. Brodeur, N. Merati, and M. M. Yoklavich. 1993. Predation on walleye pollock, *Theragra chalcogramma*, eggs and yolk-sac larvae by pelagic crustacean invertebrates in the western Gulf of Alaska. Fish. Oceanogr. 2(1):30-39.

Immunological detection of yolk protein was used to assess predation by pelagic amphipods (gammarid and hyperiid), mysids, and euphausiids on eggs and yolk-sac larvae of walleye pollock *Theragra chalcogramma*, during 1988 and 1989. Consumption estimates were made on the basis of frequency of positive immunoassays, assay detection times (gut clearance times), predator abundance, and spatial overlap of predators and prey. From the scientists' results, gammarid amphipods and euphausiids were important predators on eggs and yolk-sac larvae, respectively. Gammarid amphipods alone consumed about 14 percent of the standing stock of pollock eggs in 1989. These results were compared with those from clearance rate experiments of predators feeding on pollock eggs in 300-L bags. In general, clearance rate estimates of egg consumption were lower than those determined from gut contents.

Barlow, J., L. Fleischer, K. A. Forney, O. Maravilla-Chavez. 1993. An experimental aerial survey for vaquita, *Phocoena sinus*, in the northern Gulf of California, Mexico. Marine Mammal Science 9(1):89-94.

Boggs, C. H. 1992. Depth, capture time, and hooked longevity of longline-caught pelagic fish: timing bites of fish with chips. Fish. Bull., U.S. 90(4):642-658.

To resolve the uncertainty in estimating capture depths of fish on pelagic longline gear, electronic microchip hook timers were attached to branch lines to record when bites occurred, and time-depth recorders (TDRs) were attached to longline gear, off Hawaii in January 1989 and January-February 1990. Hook timers indicated that 32 percent of the striped marlin, *Tetrapturus audax*; 21 percent of the spearfish, T. angustirostris; and 12 percent of the bigeye tuna, *Thunnus obesus*, were caught on sinking or rising hooks, demonstrating that capture time data are needed to correctly estimate capture depth. Recorded and predicted longline depths differed greatly, indicating that TDRs are essential for describing depth distributions of fish from longline catches. Most (>60 percent) of the spearfish and striped marlin were caught on settled hooks (not sinking or rising) at depths of <120 m, whereas most bigeye tuna were caught at depths of >200 m. This suggests that eliminating shallow hooks could substantially reduce the bycatch of spearfish, striped marlin, and other recreationally important billfish without reducing fishing efficiency for bigeye tuna. Bigeye tuna and striped marlin survived up to 6-9 hours after capture, and over 50 percent of 12 frequently caught taxa were alive when retrieved, suggesting that the release of live fish can be an effective management option.

Dailey, M. D., M. L. Fast, and G. H. Balazs. 1993. *Hapalotrema dorsopora* sp.n. (Trematoda: Spirorchidae) from the heart of the green turtle, *Chelonia mydas*, with a redescription of *Hapalotrema postorchis*. J. Helminthol. Soc. Wash. 60(1):5-9.

*Hapalotrema dorsopora* sp.n. from the heart of the green turtle, *Chelonia mydas*, is described. *Hapalotrema dorsopora* differs from all other members of the genus by having a separate dorsal uterine pore. *Hapalotrema dorsopora* most resembles *Hapalotrema mehrai* but differs, in addition to separate dorsal and ventral pores, in placement of testes and vitellaria and shape of ovary. *Hapalotrema postorchis* originally described from a single specimen, is redescribed.

Edwards, E. F. 1992. Energetics of associated tunas and dolphins in the eastern tropical Pacific Ocean: a basis for the bond. Fish. Bull., U.S. 90(4):678-690.

The basis for the curious association between yellowfin tuna, *Thunnus albacares*, and spotted dolphin, *Stenella attenuata*, in the eastern tropical Pacific Ocean has never been explained. Consideration of the bioenergetics of the associated tuna and dolphins suggests that the association may be based on the combined effects of a shallow thermocline, overlapping size (length) ranges of associated yellowfin and young dolphins, congruent diets, hydrodynamic constraints on swimming speeds of dolphin schools, and social (care-giving) behavior of dolphins. Insights developed during construction and exercise of comparative bioenergetics models for the tuna and dolphin suggest that tunas are more likely to follow dolphins than dolphins to follow tunas, and that the strength of the association in a given area may be related to oceanographic conditions affecting prey distribution and abundance.

Johnson, C. M., F. B. Schwing, S. Ralston, D. M. Husby, and W. H. Lenarz. 1992. The nearshore physical oceanography off the central California coast during April-June 1988: a summary of CTD data from juvenile rockfish surveys. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-174, 34 p.

Hydrographic conditions, during four periods of approximately 10 days each in April-June 1988 in the coastal ocean bounded by Cypress Pt. (36°35′ N) and Pt. Reyes, California (38°10′ N), and from the coast to about 75 km offshore, are summarized in a series of horizontal maps and vertical transects. A total of 75 conductivity-temperature-depth (CTD) casts were obtained during the *David Starr Jordan* cruise DS-88-04; 362 casts were obtained during the cruise DS-88-06 over the course of three consecutive sweeps of the region. Data products contained in this report include (1) a master list of all CTD stations during the cruise; (2) surface meteorological time series from the region's four National Data Buoy Center meteorological buoys and a coastal station; (3) horizontal maps of temperature, salinity, sigma-t ($\sigma_t$) and other hydrographic products at depths of 5 m, 30 m, 50 m, 100 m, and 200 m; (4) temperature, salinity and $\sigma_t$ along five cross-shelf vertical transects; and (5) temperature-salinity plots.

Lee, M. M., L. K. Timme, R. VanToorenburg, and B. L. Becker. 1993. The Hawaiian monk seal on Lisianski Island, 1988 and 1990. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-179, 33 p.

Miya, R. K., and G. H. Balazs. 1993. Ecology and conservation of green turtles in the nearshore waters of Waikiki Beach. 'Elepaio 53(2):9-13.

Parrish, F. A., and R. B. Moffitt. 1993. Subsurface fish handling to limit decompression effects on deepwater species. Mar. Fish. Rev. 54(3):29-32.

A method of handling hooked fish at intermediate depth was developed for species which occur deeper than conventional scuba depths. Juvenile pink snappers, *Pristipomoides filamentosus*, were hauled from 65-1,000 m to a depth of only 30 m, where the ambient pressure change was a fraction of that produced by hauling fish to the sea surface. This method afforded a unique opportunity to acoustically tag deepwater, physoclistous fish without the need to alter the fish's original swim bladder volume and without the high risk of further injury associated with surface handling. Tagged *Pristipomoides filamentosus* survived and behaved well and were tracked successfully. This basic method could be applied to a variety of deepwater

species in a number of research approaches, including tagging and dietary studies.

Parrish, F. A., and T. K. Kazama. 1992. Evaluation of ghost fishing in the Hawaiian lobster fishery. Fish. Bull., U.S. 90(4):720-725.

Mortality due to retention of lobsters in derelict traps was evaluated over a 2-year period using two approaches. First, a string of eight empty, single-chamber, plastic traps was deployed at a 40-m depth off Oahu, Hawaii, and monitored periodically by scuba during a 6-month period in 1990. The traps were stable and remained intact despite adverse oceanic conditions. Numerous entries and exits of lobsters were recorded. For the second test, the ability of lobsters to exit traps was tested in a series of field and laboratory trials of trap strings stocked with Hawaiian spiny lobster, *Panulirus marginatus*, and slipper lobster, *Scyllarides squammosus*. The number of lobsters that died in stocked traps was less than 4 percent of the test population and differed significantly from zero only in the laboratory evaluation ($\chi^2$=5.42, $P$=0.02). The two species exited similarly; however, the pattern of exits in laboratory and field tests differed significantly ($\chi^2$=23.889, $P$=0.03). All lobsters exited within 56 days in a pattern generally approximating an exponential decline. Our evidence suggests that little direct mortality of lobsters is due to the inability to exit traps, and consequently ghost fishing by these traps is not considered a problem for spiny and slipper lobsters.

Skillman, R. A., and G. H. Balazs. 1992. Leatherback turtle captured by ingestion of squid bait on swordfish longline. Fish. Bull., U.S. 90(4):807-808.

Somerton, D. A., and B. S. Kikkawa. 1992. Population dynamics of pelagic armorhead, *Pseudopentaceros wheeleri*, on the Hancock Seamounts. Fish. Bull., U.S. 90(4):756-769.

Pelagic armorhead, *Pseudopentaceros wheeleri*, are the target of a directed trawl fishery on many of the southern Emperor-northern Hawaiian Ridge seamounts. The population dynamics of armorhead for the period 1970-90 were reconstructed for Southeast Hancock seamount, the southernmost of the seamounts commercially fished, by using commercial catch-and-effort statistics, various biological measurements, and research stock-survey data. The population declined almost continuously from a 1972 high of 5500 metric tons (t) to a 1989 low of 25 t. In addition to the intense fishery, this decline was due partly to the sporadic pattern of armorhead recruitment. Natural mortality rate was estimated as 0.54/yr; however, females had a higher mortality rate than males.

Watson, W. 1992. Proteolysis of skeletal muscle in yellowfin tuna, *Thunnus albacores*: evidence of calpain activation. Comp. Biochem. Physiol. 103B(4):881-887.

Yoshimoto, S. S., and R. P. Clarke. 1993. Comparing dynamic versions of the Schaefer and Fox production models and their application to lobster fisheries. Can. J. Fish. Aquat. Sci. 50(1):181-189.

Dynamic approaches (integrated and finite difference) to the Schaefer and Fox production models are applied to four commercial lobster fisheries. The integrated versions provide better predictions than their finite difference counterparts. Only the integrated version of the Fox model provides realistic (positive) biological parameter estimates for all four fisheries, and bootstrapping reveals those estimates to be generally stable. Additionally, this model performs well when applied to data where certain assumptions of surplus production modeling are fulfilled. The results suggest further investigation of the integration procedure.

## Approved by Science and Research Director, SWR

Balazs, G. H. Shark attacks in Hawaii, 1779-1992. For consideration for publication in L. Taylor (ed.), Sharks in Hawaii: their biology and cultural significance. Leighton Taylor Associates.

Boehlert, G. W. Fisheries of Hawaii and U.S.-associated Pacific Islands. Preface and Introduction. For consideration for publication in Marine Fisheries Review (special edition).

Dewar, H., J. B. Graham, and R. W. Brill. Studies of tropical tuna swimming performance in a large water tunnel II: thermoregulation. For consideration for publication in Journal of Experimental Biology.

Hobson, E. S., J. R. Chess, and D. F. Howard. Another way that hurricanes damage coral reefs. For consideration for publication as a letter in Nature.

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Philbrick, V. A., P. C. Fiedler, S. B. Reilly, R. L. Pitman, and L. T. Ballance. Report of ecosystem studies conducted during the 1992 eastern tropical Pacific common dolphin survey on the research vessels *David Starr Jordan* and *McArthur*. For consideration for publication in NOAA Technical Report Series.

Perrin, W. F. Tuna/dolphin: areas and species, fishing history. For consideration for publication in proceedings of UC MEXUS volume "Current crises in marine mammal management, U.S.-Mexican perspectives."

Polovina, J. J., and G. T. Mitchum. Spiny lobster recruitment and sea level revisited: results of a 1990 forecast. For consideration for publication as a Note in Fishery Bulletin, U.S.

Seki, M. P., and D. A. Somerton. Feeding ecology and daily ration of the pelagic armorhead, *Pseudopentaceros wheeleri*, at Southeast Hancock Seamount. For consid-

eration for publication in Environmental Biology of Fishes.

Squires, D. E.. Individual transferable quotas in a multiproduct pacific fishery. For consideration for publication in Rand Journal of Economics.

Squires, D., and J. Kirkley. Resource rents from single and multispecies individual transferable quota programs. For consideration for publication in ICES Journal of Marine Science.

Taylor, B. L. Monitoring conservation actions: a case study of sea turtles. For consideration for publication in the Journal of Wildlife Management.

Uchiyama, J. H., R. A. Skillman, and J. D. Sampaga. Age, growth rates, and hatch dates of larval dolphins (Corphaenidae) from Hawaiian waters. For consideration for publication in Fishery Bulletin, U.S.

## Administrative Reports

**Administrative Reports are strictly for internal use only and are not to be cited or treated as publications.**

### La Jolla, California

Mackett, D. J. 1993. Current year operation plans for fiscal year 1993. SWFSC Admin. Rep., La Jolla, LJ-93-03, about 300 p.

Bartoo, N., and D. Holts. 1993. Report on the 1992 cooperative North Pacific albacore observer project. SWFSC Admin. Rep., La Jolla, LJ-93-04, 14 p.

Tillman, M. F. 1993. Director's Report to the 44th Tuna Conference on tuna and tuna-related activities at the Southwest Fisheries Science Center for the period May 1, 1992 to April 30, 1993. SWFSC Admin. Rep., La Jolla, LJ-93-05, 41 p.

Squire, J. L., Jr., and A. F. Muhlia-Melo. 1993. Review of striped marlin, *Tetrapturus audax;* swordfish, *Xiphias gladius;* and sailfish, *Istiophorus platypterus,* fisheries and resource management by Mexico and the United States in the northeast Pacific Ocean. (English/Spanish) SWFSC Admin. Rep., La Jolla, LJ-93-06, 43 p.

### Honolulu, Hawaii

Ellis, D. M., and E. E. DeMartini. 1993. A comparison of baited video camera and Kali longline for indexing the abundance of juvenile opakapaka, *Pristipomoides filamentosus.* SWFSC Admin. Rep., Honolulu, H-93-03, 33 p.

Haight, W. R., and J. J. Polovina. 1993. Status of lobster stocks in the Northwestern Hawaiian Islands, 1992. SWFSC Admin. Rep., Honolulu, H-93-04, 23 p.

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